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Chapter 0: Fluency

Common Core Standard(s)

- Fluently divide multi-digit numbers using the standard algorithm. (6.NS.2)
- Fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation. (6.NS.3)
- Find the greatest common factor of two whole numbers less than or equal to 100 and the least common multiple of two whole numbers less than or equal to 12. Use the distributive property to express a sum of two whole numbers 1-100 with a common factor as a multiple of a sum of two whole numbers with no common factor. *For example, express* $36 + 8$ *as* $4(9 + 2)$. (6.NS.4)

Vocabulary: sum, addends, difference, divisor, dividend, quotient, product, factor, algorithm, greatest common factor, least common multiple, prime number, prime factorization, distributive property,

Appendix Overview:

It is important to note that the standards addressed in this appendix are often best taught within a specific context or standard where they are used. For example, finding greatest common factors or least common multiples are often an important component in simplifying fractions, finding least common denominators, or rewriting an algebraic expression by factoring. It would be appropriate to address these standards within the unit that focuses on fractions or algebraic expressions. For this purpose we offer these standards not only as a stand-alone unit but encourage teachers to address these standards where appropriate and maintained as a subtext throughout the whole grade.

In 6^{th} grade students consolidate the work done in previous grades on operations with whole numbers and decimals to become fluent with all four operations with these numbers. It is important to understand that in order to be fluent in these operations a student can not only implore a standard algorithm to execute an operation but they can choose methods of computation that help them arrive at their desired outcome most efficiently. This might be estimating or using mental math or they might decide to change decimals to fractions or vice versa. In addition, a student can reflect upon their answer and determine if it makes sense given the context. Throughout this chapter students will begin to see whole numbers, fractions, and decimals all as numbers that belong to the same number system, just represented in different ways. This understanding is crucial for their fluency with arithmetic operations to grow.

The chapter begins by reviewing arithmetic operation with whole numbers. In previous grades students have used models, place value charts, and properties of operations to find sums, differences, products, and quotients. They have then connected these models to the standard algorithms for all operations except division. It is likely that your students have some experience with the standard long division algorithm previous to 6^{th} grade but they have not yet reached fluency. After students have reviewed the standard algorithms for addition, subtraction, and multiplication students will connect place value models with the standard long division algorithm. They will draw on their knowledge of place value as they aim for fluency in dividing multi-digit numbers with the algorithm, addressing standard 6.NS.2

The next section focuses on finding the least common multiple, greatest common factor, and using these skills to rewrite a the sum of two whole numbers using the distributive property as multiple of a sum of two whole numbers with no common factor. This prepares them for writing equivalent algebraic expressions later on in 6^{th} grade and in future grades.

In the last section of this appendix students return to working with arithmetic operations. They apply the knowledge and skills learned in previous grades and from the first section of this appendix to add, subtract, multiply, and divide multi-digit decimals. They practice each of these operations and aim to obtain fluency not only in mastering algorithms but through estimating and using mental math.

Connections to Content:

Prior Knowledge:

In previous grades students have achieved fluency in adding, subtracting, and multiplying multi-digit whole numbers. They have founds whole-number quotients with up to four-digit dividends and two-digit divisors, using strategies based on place value, the properties of operations, modeling, and/or the relationship between multiplication and division. It is not until 6^{th} grade that they connect these strategies to a division algorithm for multi-digit numbers and extend their work to numbers with any given number of digits. In 5^{th} grade students add, subtract, multiply, and divided decimals to hundredths, using concrete models or drawing and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction. They relate these strategies to a written method but have not yet solidified a connection to the standard algorithm. Again, it is in 6^{th} grade that students solidify this connection and extend their knowledge to work with decimals beyond hundredths and ultimately gain fluency.

In 4^{th} grade students study factors and multiples and the dual relationship that they hold. They have also learned how to determine whether a given whole number in the range 1-100 is prime or composite. In 3^{rd} grade students relate multiplication to the area of a rectangle and use area models to represent the distributive property.

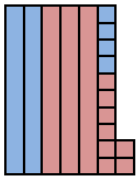
Future Knowledge:

Fluency in the arithmetic operations for multi-digit whole numbers will help students to perform these operations with integers and rational numbers in 7^{th} grade. Operations with decimals are particularly helpful when students learn to convert a rational number to a decimal using long division and in turn determine whether or not a number is rational. It is true that in the future many decimal operations will be performed with a calculator; however fluency will help a student reflect upon whether the answer the calculator gives them makes sense. Fluency also helps them to use strategies of mental math and estimation to obtain answers with ease and efficiency rather than always having to reach for a calculator. Also if students are fluent in changing decimals to fractions and vise versa they add to another great strategy for problem solving to their "tool box"

Using the distributive property to "factor out" a greatest common factor from a sum two whole numbers prepares students to write equivalent expressions for polynomials. This in turn lays a foundation for simplifying rational expressions with polynomials. In addition students will use a greatest common factor to simplify fractions and the least common multiple to find a least common denominator.

MATHEMATICAL PRACTICE STANDARDS

	**Make sense of problems and persevere in solving them.**	Roxy has created a new cherry chocolate treat to sell in her store. She packages the cherry chocolates into tubes, boxes, and cases. Each tube contains 10 cherry chocolates, each box contains 10 tubes, and each case contains 10 boxes. Roxy has made 1851 cherry chocolates and has received requests from 12 schools for the treats. She would like to give each school the same number of cherry chocolates. Determine how many cherry chocolates each school will receive and the number of cases, boxes, tubes, and pieces of cherry chocolates each school will receive. *As students work on this problem they must draw upon their experience with place value. They must infer what arithmetic operation will give them the desired outcome and also how they can express the desired outcome in terms of the number of boxes, tubes, and loose pieces of chocolate. They must be able to explain the correspondence between any modeling they have done and the division algorithm. Finally they must reflect upon their answer given the context of the problem being sure to make sense of the remainder left over.*
	**Reason abstractly and quantitatively.**	Explain in your own words how you know that a number is divisible by 4 if the last two digits form a number that is divisible by 4. *As students explore why different divisibility rules work they break down numbers into powers of 10 or 100. They must think abstractly as they analyze the powers of 100 (as is the case for divisibility of 4) and infer that all powers or multiples of 100 are divisible by 4. They decontextualize the given number and reason that this is true for all numbers that are divisible by 4. They can then conclude that since this is true they need only consider tet divisibility of the last two digits.*
	**Construct viable arguments and critique the reasoning of others.**	Roxy's cashier has made some calculations for some of the purchases at the candy store and has made some mistakes, his work is shown below. For problems 5, 6, and 7 go through each transaction and determine the mistake, explain how to perform the calculation correctly and fix the mistake. *Throughout this appendix you will find several problems that take on the form of "Find, Fix, and Justify" For these problems students analyze another student's work and must identify mistakes in the work. They make arguments as to why something is wrong by pointing out explicit errors observed. Once they fix the mistake they must justify why their reasoning is correct.*
	**Look for and express regularity in repeated reasoning.**	Describe each pattern given below, then find the next two terms. a. $1, 0.3, 0.09, 0.027$ ... b. $17, 0.17, 0.0017$... c. $10, 15, 22.5, 33.75$ ... *When multiplying decimals students must recognize the regularity in how the placement of decimal in the final product behaves. In this example not only do students see a pattern in the sequence of given numbers but they must know how multiplying each term by a decimal factor will produce the next term.*

	Model with mathematics.	Marta has created the model below. She claims that this model can be used to represent the sum of 24 and 38.  1. If Marta's claim is true, what is the value of the small square? 2. What is the value of a rod (long rectangle)? 3. Find the sum of 24 and 38 using the addition algorithm and discuss how this relates to the model above. *Modeling is an important component in helping students understand the fluency standards. In previous grades students used base-ten blocks to model addition for whole numbers and numbers with decimals up to hundredths. The blocks and model help students to understand why we "carry" as we bundle into groups of ten when using the addition algorithm. As students analyze these models they extend this understanding to adding decimals greater than hundredths. Modeling is used to help students connect all of the arithmetic operations to their respective algorithm.*
	Attend to precision.	After delivering all of the candy to the schools Roxy has earned $73 in tips for making the deliveries. She decides to split the tip money between she and her 3 employees. How much tip money will each person receive? *In order to communicate the answer to this problem with precision students must reflect upon the context of the problem For this context it makes sense to report the quotient as a decimal and not as a remainder because we want to know exactly how much money everyone will receive.* After making the calculation above Roxy realizes that she forgot to include the two delivery truck drivers when making her tip calculation. How much money will each person receive if she tips herself, her three employees, and the two delivery truck drivers? Check your answer with a calculator. *Once again students must not only reason about the correct way (quotient with a decimal, fraction, or remainder) to report this answer but also understand that they need only find the quotient to the nearest hundredth. Since this context deals with money we only care about the amount to the nearest cent since you cannot break up a penny. This is an example of how they must accurately and effectively express a numerical answer with a degree of precision appropriate for the problem context.*

<table>
<tr>
<td>  </td>
<td>Look for and make use of structure.</td>
<td>Find the GCF of the two numbers in each given sum. Use the distributive property to write an equivalent expression to the sum that contains the GCF as one of its factors. How do you know that you found the correct equivalent expression?
<table>
<tr><td>a. 42 + 14</td><td>b. 36 + 27</td></tr>
<tr><td>c. 55 + 44</td><td>d. 16 + 72</td></tr>
</table>
In the example above students must rewrite a given sum as an equivalent expression using the distributive property. To do so they must understand how you can decompose a number into a product of its factors. This understanding demonstrates knowledge about the structure of these sums and products. In part a above should be able to see the expression 42+14 as a single sum of 56, as adding to positive whole numbers, or as a multiple of a sum of two whole numbers with no common factor.</td>
</tr>
<tr>
<td>  </td>
<td>Use appropriate tools strategically.</td>
<td>After making the calculation above Roxy realizes that she forgot to include the two delivery truck drivers when making her tip calculation. How much money will each person receive if she tips herself, her three employees, and the two delivery truck drivers? Check your answer with a calculator. The quotient in this problem will contain a repeating decimal of 6. When students check their answer with a calculator they will see that the calculator often reports a digit of 7 at the end of their calculator screen. This gives them the opportunity to discuss how the calculator has rounded their answer and why it would do this. It is also important to discuss how different key strokes on a calculator can indicate division. For example inputting numbers as fractions.</td>
</tr>
</table>

Section 0.1: Arithmetic Operations with Whole Numbers

Section Overview:
This section specifically addresses a student's ability to fluently add, subtract, multiply, and divide multi-digit decimals using the standard algorithm for each operation. In the first lesson students review how models connect to the standard algorithms for addition, subtraction, and multiplication. In previous grades students have done extensive work in relating these models to the standard algorithm for these operations so this lesson gives students the opportunity for them to now solidify their knowledge and practice fluency. In the next lesson students develop the standard algorithm for division using place value models. While they have found quotients of multi-digit numbers in previous grades their work with a standard algorithm for division has not been as extensive has with the other operations. This second lesson provides students with the opportunity to practice the algorithm and work on fluency with division.

Concepts and Skills to Master in this Section:

By the end of this section, students should be able to:

1. Fluently add multi-digit numbers using the standard algorithm.
2. Fluently subtract multi-digit numbers using the standard algorithm.
3. Fluently multiply multi-digit numbers using the standard algorithm.
4. Fluently divide multi-digit numbers using the standard algorithm.

0.1a Class Activity: Arithmetics Operations with Whole Numbers

Roxy is ordering candy to re-stock some items at her candy shop. Answer each of her questions below without using a calculator. Show your work and be ready to discuss how you answered each question.

1. A case of Mega Mania Jaw Breakers cost $12 each, how much will 26 cases Mega Mania Jaw Breakers cost?

2. An entire case of Old Fashion Root Beer is $43. If Roxy gets a discount of $15 off, how much will the case of root beer cost?

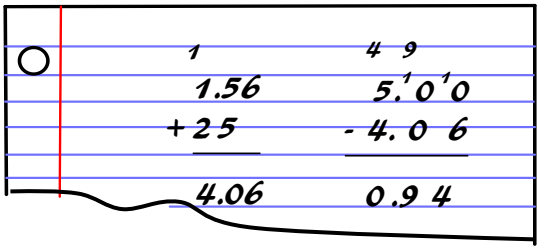
3. I spent $117 on boxes of Tangy Licorice Ropes, each box costs $9. How many boxes of licorice ropes did I buy?

4. I would like to buy a case of Chocolate Nut Clusters for $115 and a case of Whopper Hoppers for $86. How much will these two items cost altogether?

Find, Fix, and Justify

Roxy's cashier has made some calculations for some of the purchases at the candy store and has made some mistakes, his work is shown below. For problems 5, 6, and 7 go through each transaction and determine the mistake, explain how to perform the calculation correctly and fix the mistake.

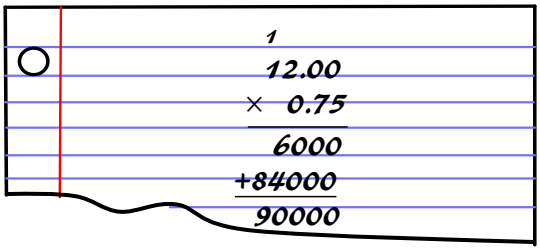
5. Corey buys two different candies at Roxy's store. One is a box of Fruity Frogs for $1.56 and the other is a piece of Tangy Taffy for $0.25. Corey has a 5-dollar bill. How much money does Corey owe the cashier and how much money should he get back?



Corey should get $0.94 back in change.

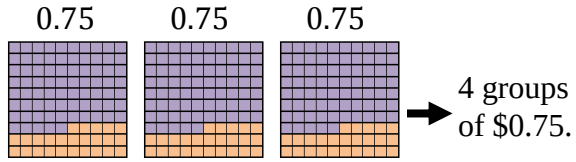
Find, Fix, and Justify Continued

6. Lola is buying Gooey Glow Worms for each of her 12 cousins. The worms cost $0.75 each. How much will all the worms cost together?

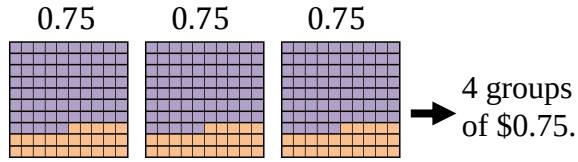


Altogether the worms will cost $90,000.

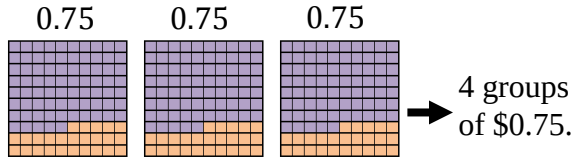
7. Lola decides to just spend all the money she has on the $0.75 Gooey Glow Worms. She has $11, how many worms can she get?



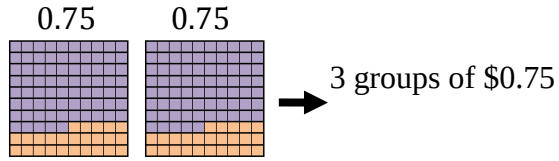
$0.25 + 0.25 + 0.25 = 0.75$



$0.25 + 0.25 + 0.25 = 0.75$



$0.25 + 0.25 + 0.25 = 0.75$



$0.25 + 0.25 = 0.75$

$4 + 4 + 4 + 3 = 15$ Gooey Glow Worms

Lola can buy 15 Gooey Glow Worms.

0.1a Homework: Arithmetic Operations with Whole Numbers

Directions: Estimate each sum, difference, product or quotient. Then use an algorithm or model to find the exact answer.

1. $435 + 269$	2. 269×4	3. $435 - 269$
4. $450 \div 15$	5. $43500 - 26$	6. 435×269

7. At 9:00 on election night, the ballot count is shown in the table below.

Candidate A	Candidate B
47560	44127

But now the returns from District 10 are just in: 2316 votes in District 10 cast for candidate A, and 7387 for candidate B: Who is now in the lead and by how many votes?

8. To date, my orchard has produced 23,420 bushels of apples and 16,870 bushels of pears. A bushel of apples brings in $7.00 and a bushel of pears brings in $10. To sustain my orchard, I need to make in $300,000. Assuming the ratio of apples to pears remains the same; about how many more bushels of apples and pears do I need to collect to sustain the orchard? Justify your answer.

9. Gianni, Sylvia and Lester are at Lagoon, and they want to ride the Loop-de-loop and tickets are $5.50 each. Gianni has $4.50, Sylvia has $7.50 and Lester has $4.50. Can they pool their resources and all ride the Loop-de-loop? Justify your answer.

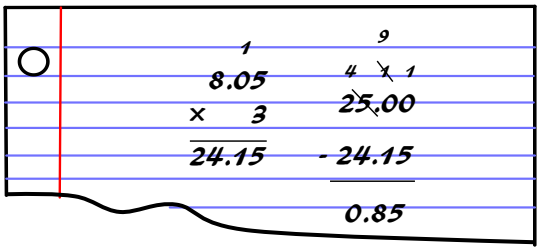
Find, Fix, and Justify

A cashier has made some calculations for some of the purchases at the hardware store and has made some mistakes, her work is shown below. For each problem go through every transaction and determine the mistake, explain how to perform the calculation correctly, and fix the mistake.

10. Clara buys a part for the faucet on her kitchen sink that costs $1.81. She gives the cashier a 10-dollar bill. How much money should the cashier give her back?

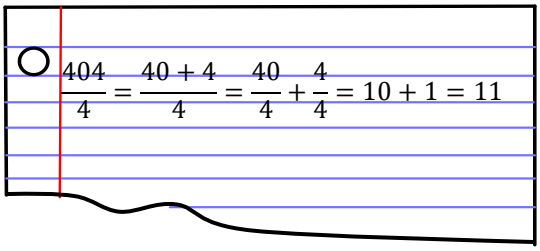
If it costs $1.81 and she gave me $10.00, how much is between 1.81 and 10.00? The difference between 10 and 1 is 9 and the difference between 100 and 81 is 19. If I add those two differences together I get $9.19. She should get $9.19 back.

11. Jackson buys 3 large pieces of plywood for $8.05 each. He has a 20-dollar bill and a 5-dollar bill which he gives the cashier. He then insists on digging around in his pocket to find an extra $0.15 to give the cashier as well. Jackson says it will make the calculation easier. How much money does he get back?



8.05 × 3 is $24.15. Jackson has $25 to give me. If I subtract $24.15 from $25 I get $0.85. Why is he insisting on giving me an extra $0.15 too?

12. Nancy finds some really great light fixtures on sale for her new home? The sign says that you can 4 lights fixtures for $404.00. She asks the cashier how much each light fixture costs.



I can use partial quotients by splitting my dividend up. $404 = 40 + 4$. Then I can divide each piece by 4 and add my two quotients together to get the cost of each fixture. Each fixtures csots $11.

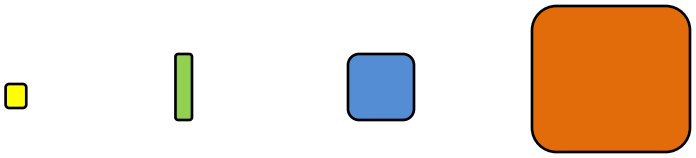
0.1b Class Activity: Dividing Multi-Digit Numbers

Part 1: Roxy has received orders from several different schools requesting candy from her store for their school fundraiser. She has recorded the amount of each type of candy she has in stock and the number of schools that want each type of candy in the table below. She would like to give each school that requests a certain type of candy the exact same amount of candy to be fair. Study the table and without calculating, estimate if the amount of candy that each school receives is correct. Justify your answer.

Type of Candy	Truffle Troll Treats	Rainbow Drops	Lemon Swirly Pops
Amount in Stock	6255	154	4950
Number of schools requesting this candy	15	9	20
Amount of candy each school receives	417	14	247.5

Part 2:

Roxy has created a new cherry chocolate treat to sell in her store. She packages the cherry chocolates into tubes, boxes, and cases. Each tube contains 10 cherry chocolates, each box contains 10 tubes, and each case contains 10 boxes.



1 piece | Tube: 10 pieces | Box: 10 Tubes | Case: 10 Boxes

**Figures not drawn to scale*

Roxy has made 1851 cherry chocolates and has received requests from 12 schools for the treats. She would like to give each school the same number of cherry chocolates. Determine how many cherry chocolates each school will receive and the number of cases, boxes, tubes, and pieces of cherry chocolates each school will receive.

Part 2 Continued:

Part 3 

After delivering all of the candy to the schools Roxy has earned $73 in tips for making the deliveries. She decides to split the tip money between she and her 3 employees. How much tip money will each person receive?

After making the calculation above Roxy realizes that she forgot to include the two delivery truck drivers when making her tip calculation. How much money will each person receive if she tips herself, her three employees, and the two delivery truck drivers?

Directions: Estimate each quotient. Then use the standard algorithm to find the exact quotient.

1.	2.	3.	4.
$14\overline{)322}$	$12\overline{)5484}$	$115\overline{)8625}$	$205\overline{)21115}$

5.	6.	7.	8.
$20\overline{)361}$	$41\overline{)4970}$	$352\overline{)6890}$	$6\overline{)108.75}$

Find, Fix, and Justify

9. Owen has completed the following division problem and has made a mistake. Find the mistake and explain what Owen has done wrong. Then solve the division problem correctly.

$$
\begin{array}{r}
561.\overline{22} \\
45\overline{)25245.00} \\
-\ 225 \\
\hline
275 \\
-\ 270 \\
\hline
55 \\
-\ 45 \\
\hline
100 \\
-\ 90 \\
\hline
100 \\
-\ 90 \\
\hline
100
\end{array}
$$

0.1b Homework: Dividing Multi-Digit Numbers

Directions: Without calculating determine which of the following quotients are correct. Justify your answer.

1. $152 \div 14 = 2128$
2. $4508 \div 92 = 49$
3. $14880 \div 124 = 1200$

4. Marty manufactures special bolts for motorcycles in his garage. He has packaged 1 case, 5 boxes, 1 tube, and 2 individual bolts to be sent to 14 motorcycle shops. Marty packages 10 individual bolts in 1 tube, 10 tubes in one box, and 10 boxes per case. Draw a picture or model that represents how the bolts are packaged, and then determine how many cases, boxes, tubes, and individual bolts will be sent to each of the 14 motorcycle shops Explain why your answer makes sense.

Directions: Estimate each quotient. Then use the standard algorithm to find the exact quotient. Express remainders as decimals.

5. $78 \div 6$	6. $352 \div 16$	7. $540 \div 18$	8. $49{,}815 \div 405$	9. $578 \div 32$

Directions: Estimate each quotient. Then use the standard algorithm to find the exact quotient. Express remainders as decimals.

10. $4{,}635 \div 45$	11. $6{,}996 \div 212$	12. $1{,}018 \div 72$	13. $326 \div 8$	14. $40613601 \div 4263$

Find, Fix, and Justify

15. An airplane travels 18,032 miles in 45 hours. Pablo has completed the following division problem to determine the plane's speed in miles per hour and has made a mistake. Find the mistake and explain what Pablo has done wrong. Then solve the division problem correctly.

$$
\begin{array}{r}
47.\overline{1} \\
45\overline{)18032.00} \\
-\,180 \\
\hline
0320 \\
-\,315 \\
\hline
50 \\
-\,45 \\
\hline
50
\end{array}
$$

16. Monique has correctly found the quotient below doing long division. Use her work shown to find each product.

$$
\begin{array}{r}
172 \\
24\overline{)4128} \\
-\,24 \\
\hline
172 \\
-\,168 \\
\hline
48 \\
-\,48 \\
\hline
0
\end{array}
$$

a. 172×24

b. 70×24

c. 2×24

Section 0.2: Factors and Multiples

Section Overview:
The first lesson in this section in on divisibility rules, while divisibility rules are not addressed in a specific standard for 6^{th} grade, being able to draw upon them makes working with factors and multiples much easier for students, especially when dealing with larger numbers. They are also very helpful when executing the algorithm for long division. As students investigate how and why the divisibility rules work they not only come away with a quick trick for divisibility but also engage in meaningful discussions about place value and powers of ten. In the next two lessons students learn how to find the greatest common factor (GCF) of two whole numbers less than or equal to 144 and the least common multiple (LCM) of two whole number less than or equal to 12. They also engage in several application problems where finding the LCM and GCF help you reach a desired outcome. In the last few lessons students review the distributive property and how it relates to an area model. These area models are then used to help students express a sum of two whole numbers 1-100 with a common factor as a multiple of a sum of two whole numbers with no common factor.

Concepts and Skills to Master in this Section:

By the end of this section, students should be able to:

1. Determine if a number is divisible by 2, 3, 4, 5, 6, 9, or 10.
2. Find the greatest common factor of two whole numbers less than or equal to 144.
3. Find the least common multiple of two whole numbers less than or equal to 12.
4. Use the distributive property to express a sum of two whole numbers with a common factor as multiple of a sum of two whole numbers with no common factor.

0.2a Class Activity: Divisibility Rules

1. A marching band has 72 members that will march during halftime in a football game. They need to march in rows with the same number of students in each row. How many ways different ways can the band members be arranged? Explain the arrangements.

Two or more numbers that are multiplied to form a **product** are called **factors**.

$$8 \times 9 = 72 \longleftarrow \text{Product}$$

Factor

This shows that 8 and 9 are factors of 72 because they each divide 72, with no remainder leftover. We say that 72 is **divisible** by 8 and 9.

Often you can test if one number is divisible by another number mentally rather than doing long division to see if there is a remainder. To test a number mentally you can use a Divisibility Rule.

Divisibility Rule for 2: Use the space provided to write down your thoughts and ideas from the class discussion.

2. Explain using words, pictures, examples, or equations why a number is divisible by 2 if the last digit is even and why a number is not divisible by 2 if the last digit is odd.

3. Write 5 numbers, each with a different number of digits, which are divisible by 2.

Divisibility Rule for 10: Use the space provided to write down your thoughts and ideas from the class discussion.

4. Explain using words, pictures, or equations why you know that a number is divisible by 10 if the last digit 0.

5. Write 5 numbers, each with a different number of digits, which are divisible by 10.

Divisibility Rule for 5: Use the space provided to write down your thoughts and ideas from the class discussion.

6. Explain in your own words why you know that a number is divisible by 5 if the last digit 0 or 5.

7. Write 5 numbers, each with a different number of digits, which are divisible by 5

Divisibility Rule for 4: Use the space provided to write down your thoughts and ideas from the class discussion.

8. Explain in your own words how you know that a number is divisible by 4 if the last two digits form a number that is divisible by 4.

9. Write 5 numbers, each with a different number of digits, which are divisible by 4.

Divisibility Rule for 3 and 9: Use the space provided to write down your thoughts and ideas from the class discussion.

10. Write 3 numbers, each with a different number of digits, which are divisible by 3.

11. Write 3 numbers, each with a different number of digits, which are divisible by 9.

Divisibility Rule for 6: Use the space provided to write down your thoughts and ideas from the class discussion.

12. Write 3 numbers, each with a different number of digits, which are divisible by 6.

13. Summarize the Divisibility Rules below by completing each statement.

A number is divisible by:

- 2 if
- 3 if
- 4 if
- 5 if
- 6 if
- 9 if
- 10 if

15. Determine if each given number is divisibly by 2, 3, 4, 5, 6, 9, or 10. Justify your answer.
    a. 5040

    b. 955

16. Circle all the numbers that are factors of 15,033,444.

2 3 4 5 6 9 10

0.2a Homework: Divisibility Rules

Directions: Use divisibility rules to determine whether each number is divisible by 2, 3, 4, 5, 6, 9, or 10. Justify your response.

1. 6,480	2. 135	3. 24,640
4. 549	5. 10,523	6. 58,762

7. Circle all the numbers that are factors of 6,420.

2 3 4 5 6 9 10

For problems 8-10 find a number that matches each description

8. A 3-digit number that is divisible by 2, 3, and 6. How do you know?	9. A 3-digit number that is divisibly by 3 and 4. How do you know?
10. A 4-digit number that is divisibly by 5 and 9 but not divisibly by 10. How do you know?	11. A 4-digit number that is not divisible by 2, 3, 5, or 10.

12. Determine whether each statement is true or false. Justify your answer.
    a. If a number is divisibly by 9 it is divisible by 3.

    b. If a number is divisibly by 3 is it divisible by 9.

13. Emily delivers newspapers on Sunday mornings. Each Sunday she must deliver 112 newspapers, she likes to organize them into stacks of equal numbers and deliver one stack at a time. What size of stacks can she make?

14. You are the senior member of a team of 9 realtors in an agricultural real estate agency. When a sale is executed all partners receive equal shares, and if there is a remainder, the remainder goes to you as senior partner. In the month of October last year, the following sales were made:
    12,017 acres 77,760 acres 11,010 acres 40,500 acres.
    How many more acres did you get over the rest of the sales team?

0.2b Class Activity: Greatest Common Factor

1. Giada is planting tulip bulbs in a flower garden at her plant nursery. She has 36 tulip bulbs that she would like to plant. She wants to plant them in rows of equal size and use all her bulbs. How many rows of tulips can she plant? List all the possible combinations by organizing your numbers in a table and explain your answer.

2. Giada also has 24 daffodil bulbs that she would like to plant. Similarly she wants to plant the daffodils in rows of equal size and use all of her bulbs. How many rows of daffodils can she plant? List all combinations by organizing your numbers in a table and explain your answer.

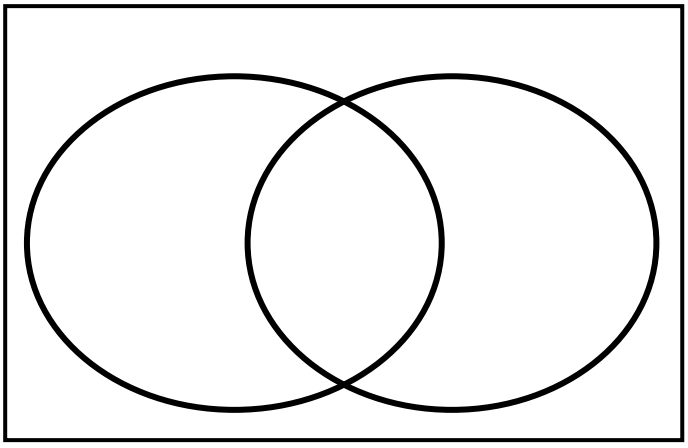
3. Giada decides to just plant the tulip and daffodils next to each other since they bloom around the same time of year and look so pretty together. She would like to use all of her bulbs and wants each row to have an equal number of tulips and an equal number of daffodils. How many rows can she make? List all combinations by organizing your numbers in a table. Justify your answer.

4. What is the greatest number of rows she can make by combining the tulips and daffodils together?

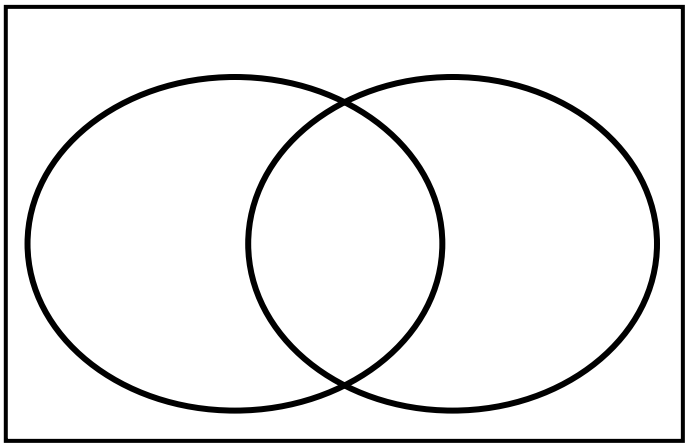
5. In the box write down what a Greatest Common Factor is.

Greatest Common Factor (GCF):

6. Use a Venn Diagram to find the GCF of pair of numbers.
   a. 30 and 36



   b. 30 and 75



7. Make a list of factors to find the GCF of each pair of numbers.

a. 16 and 56

b. 21 and 45

c. 32 and 54

d. 25 and 50

e. 51 and 85

f. 40 and 63

Sometimes it can be time consuming to list all of the factors of a number especially if it is a really big number. Rather than writing out a list of factors for each number you can use the each number's prime factorization to find the greatest common factor.

 To find the ***prime factorization*** for a number write the number as a product of its prime factors. To do this we will make a ***factor tree.***

8. Make a factor tree to write the prime factorization for each number.

a. 60	b. 88
c. 136	d. 96

10. Find the prime factorization for each number in a given pair. Then use the prime factorization to find the GCF.

a. 12 and 56	b. 27 and 63
c. 72 and 84	d. 112 and 96

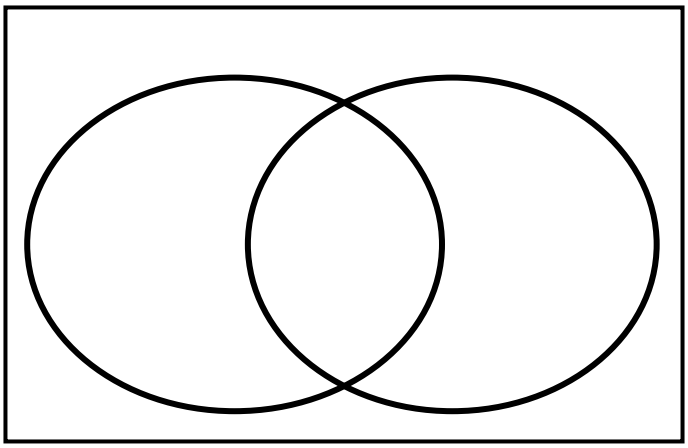
11. Valerie is assembling "goodie" bags for her friends. She has 92 trading cards and 23 mood rings to put into the bags. What is the greatest number of bags that she can assemble with no items left over? How many of each item will be in each bag?

12. There are 60 girls and 48 boys that want to participate in a STEM competition. If each team must have the same ratio of girls to boys what is the greatest number of teams than can participate? How many girls and boys will be on each team?

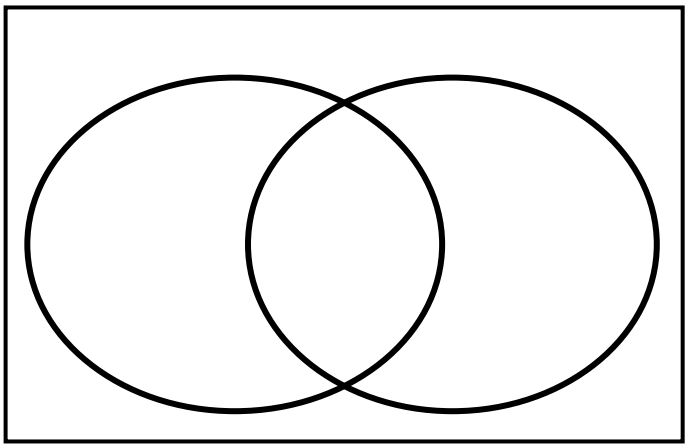
0.2b Homework: Greatest Common Factor

Make a Venn diagram to find the GCF of each pair of numbers.

1. 35 and 40



2. 20 and 80



Make a list to find the GCF of each pair of numbers.

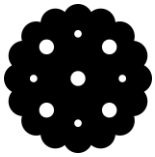
3. 30 and 50	4. 20 and 64
5. 45 and 60	6. 14 and 35

Find the GCF of each pair of numbers by writing each number as its prime factorization.

7. 42 an 70	8. 96 and 144

9. 15 and 75	10. 85 and 70

11. A caterer has 90 mini macaroons and 120 gingersnaps to arrange on plates. He wants each plate to have the same number of macaroons and each plate to have the same number of gingersnaps.



a. What is the largest number of plates possible?

b. How many macaroons and how many gingersnaps will be on each plate?

12. In a parade, 36 members of a cheerleading squad are to march in front of 120 members of the high school band. Each row is to have the same number of cheerleaders and each row is to have the same number of band members.

a. Find the greatest number of rows possible for the parade?

b. How many cheerleaders and how many band members will be in each row?

13. Laney is covering the surface of a table with equal-sized tiles. The table is 30 inches long and 24 inches wide.

    a. What is the largest square tile that Laney can use and not have to cut any tiles?

    b. How many tiles will Laney need?

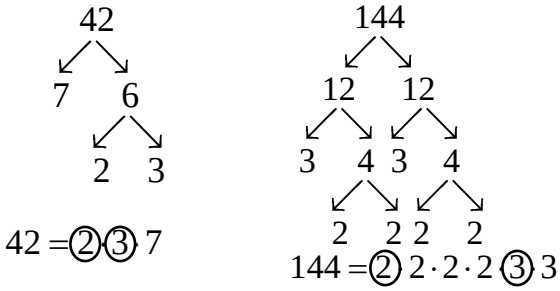
14. Circle the pairs of numbers that have a GCF of 15?

- 30 and 60
- 45 and 75
- 21 and 45
- 10 and 15

17. Write a pair of numbers whose GCF is 10.

18. Write a pair of numbers whose GCF is 8.

19. Find, Fix, and Justify
    Find the error in finding the GCF of 42 and 144 in the problem shown. Explain why it is wrong and fix the mistake.



$GCF = 2 \cdot 3 \cdot 2 \cdot 3 = 6 \cdot 6 = 36$

20. True or False. Justify your answer with an example or counter-example.
    a. The GCF of two even numbers is always 2

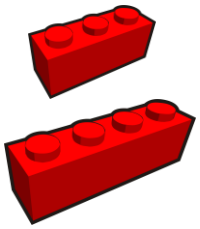
    b. The GCF of two prime numbers is always 1

    c. Can the GCF of two numbers ever be one of the numbers?

    d. Can the GCF of two numbers ever be greater than one of the numbers?

0.2c Class Activity: Least Common Multiple

1. Brooks is making a house out of LEGOS. He snaps two rows of LEGOS down onto his mat. In one row he only uses LEGOS with 3 studs; in another row he only uses LEGOS with 4 studs. His mat is only 50 studs long and he wants to make the rows the same length.



   a. How many of each type of LEGO, 4 stud and 3 stud, can he use in each row, remembering that the rows need to be the same length? If needed use the grid paper below to help you answer.

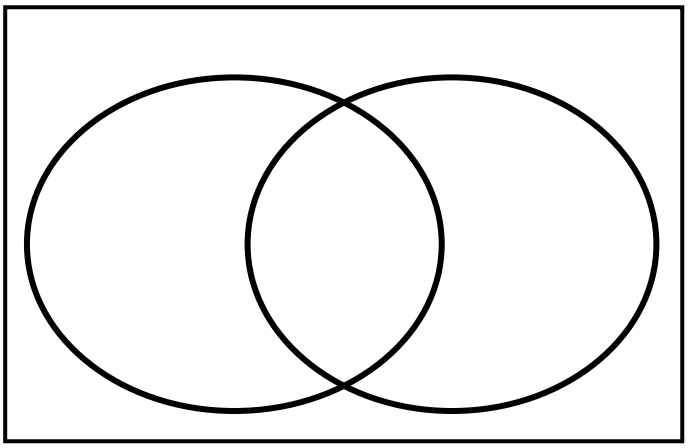
   b. What is the smallest possible stud length for the rows? How many of each block will be in these rows.

2. In the box write down what a Least Common Multiple is.

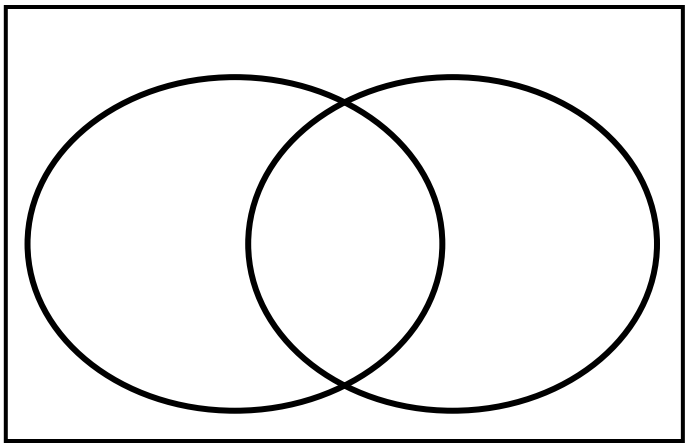
Least Common Multiple (LCM):
The Least Common Multiple between a pair of numbers is the smallest multiple that the two numbers have in common.

3. Use a Venn diagram to find the LCM of pair of numbers.

a. 4 and 9



b. 5 and 10



4. How are factors related to multiples?

5. Make a list of multiples to find the LCM of each pair of numbers.

a. 9 and 12

b. 8 and 6

c. 12 and 3

d. 4 and 10

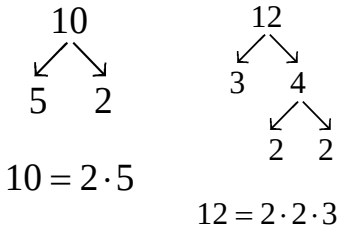
e. 6 and 11

f. 9 and 10

Sometimes it can be time consuming to list all of the multiples of a number. Rather than writing out a list of multiples for each number you can use the each number's prime factorization to find the least common multiple.

Example

To find the LCM of 10 and 12 we begin by writing each number as its prime factorization.



$10 = 2 \cdot 5$

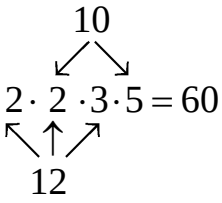
$12 = 2 \cdot 2 \cdot 3$

Recall we are looking for a multiple of both 10 and 12. That means that 10 and 12 must both be factors of this number we are looking for. Thus this number's prime factorization must include the prime numbers that are in the prime factorizations of 10 and 12.

$$10 = 2 \cdot 5$$
$$12 = 2 \cdot 2 \cdot 3$$

To be a multiple of 10 its prime factorization must include a 2 and a 5 and to be a multiple of 12 its prime factorization must include 2, 2, and 3. In order to be a multiple common to both 10 and 12 we must meet the factor criteria for both numbers by multiplying these factors together. However we want the least common multiple. That means that we only need to include the 2 two times.

$2 \cdot 2 \cdot 3 \cdot 5 = 60$



6. Find the prime factorization for each number in a given pair. Then use the prime factorization to find the LCM.

a. 9 and 12	b. 8 and 18

c. 20 and 50	d. 12 and 20

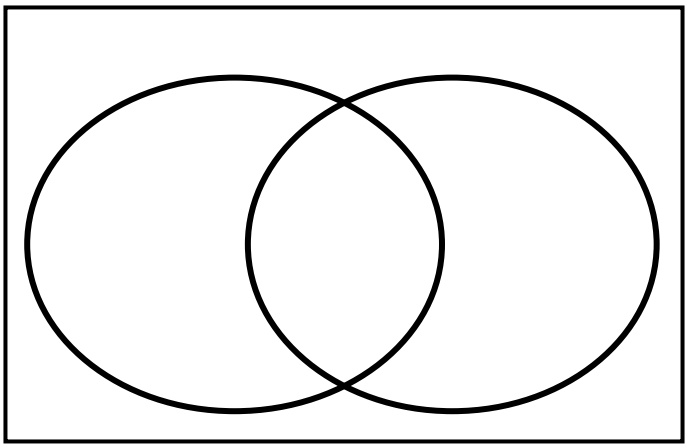
7. Two small gears are aligned by a mark drawn down the center of one gear to the center of the other gear. The first gear has 6 teeth and the second gear has 20 teeth. How many revolutions does the first gear need to make so the center lines match up again?

8. Plastic forks come in packages of 10 and plastic knives come in packages of 8. If you want one fork for each knife at a party with none leftover what is the least amount of forks and knives that you need to buy? How many packages of forks and knives will you buy?

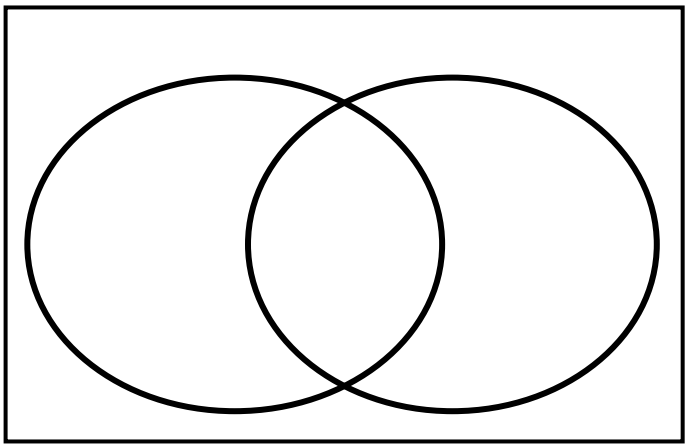
0.2c Homework: Least Common Multiple

Make a Venn diagram to find the LCM of each pair of numbers.

1. 2 and 12



2. 6 and 9



$GCF = 20$

Make a list to find the LCM of each pair of numbers.

3. 6 and 15	4. 12 and 18
5. 5 and 8	6. 20 and 4

Find the LCM of each pair of numbers by writing each number as its prime factorization.

7. 9 an 60	8. 18 and 45

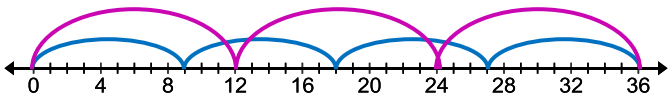
9. 12 and 18	10. 30 and 50

11. One racecar driver can circle a one-mile track in 25 seconds. Another driver takes 20 seconds to circle the same track. If they both start at the same time, in how many seconds will they be together again at the starting line? How many laps will each car have made?

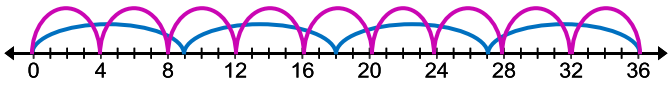
12. Each morning starting at 7:00 am a city train makes a stop at a certain street corner every 15 minutes. On that same corner a city bus makes a stop every 12 minutes. When will the train and the bus be at this corner at the same time?

13. Which model represents an LCM that is different than the other 3? Justify your answer.

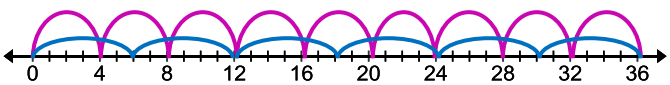
a.



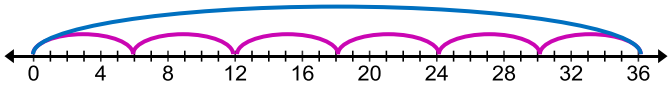
b.



c.



d.



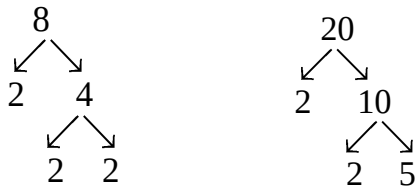
14. Circle the pairs of numbers that have a LCM of 80?

- 16 and 20
- 5 and 16
- 8 and 10
- 20 and 4

15. Write a pair of numbers whose LCM is 15.

16. Write a pair of numbers whose LCM is 60.

17. Find, Fix, and Justify
Find the error in finding the LCM of 8 and 20 in the problem shown. Explain why it is wrong and fix the mistake.



$8 = 2 \cdot 2 \cdot 2$ $20 = 2 \cdot 2 \cdot 5$

$LCM = 2 \cdot 2 \cdot 5 = 20$

18. True or False. Justify your answer with an example or counter-example.

a. The LCM of two different prime numbers is their product.

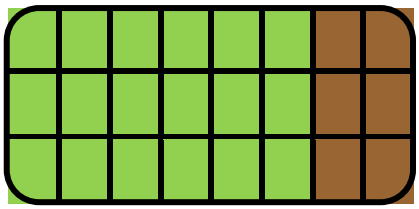
b. The LCM of two numbers will always be bigger than both of the numbers.

c. If two numbers do not contain any factors in common, then the LCM of the two numbers is 1.

d. The LCM of two numbers is greater than the GCF of the numbers.

0.2d Class Activity: The Distributive Property

Gordon and Cynthia have made a pan of brownies and have cut them into squares. They have also decided to frost the brownies with mint frosting but have left some of the pieces unfrosted for their friends that don't like frosting as shown.



1. How many total brownies are there? Write down a mathematical sentence to show how you arrived at your answer.

2. Gordon states that to find the total number of brownies in the pan he counted the number of rows of brownies and multiplied that number by the number of columns of brownies. Write down a mathematical sentence that represents Gordon's thinking.

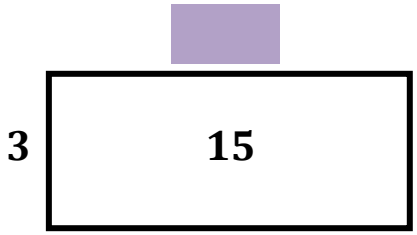
3. Cynthia states that she found the number of frosted brownies first and then she found the number of unfrosted brownies. Once she found the number of each she added them together to find the total. Write down a mathematical sentence that represents Cynthia's thinking.

4. Explain why Cynthia and Gordon each arrived at the same answer.

Name the factor, product, or addend that is missing from the area model. Then write a mathematical equation that shows the multiplication that the area model represents. Models are not drawn to scale.

5.

6.



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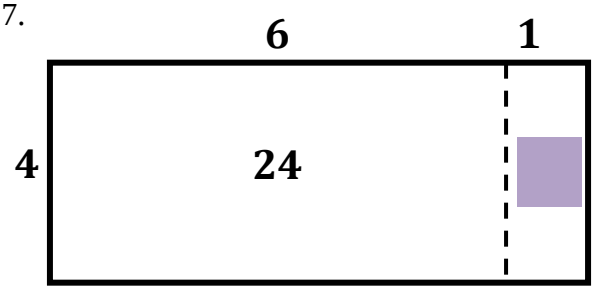

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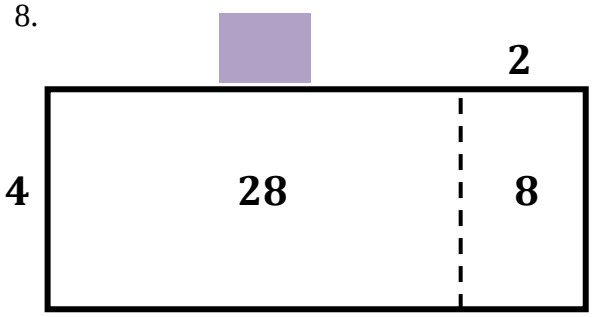

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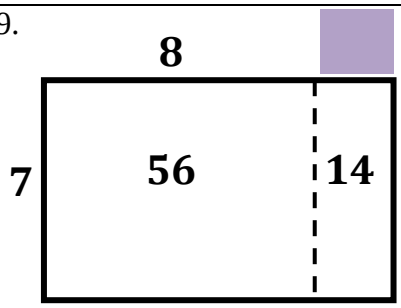
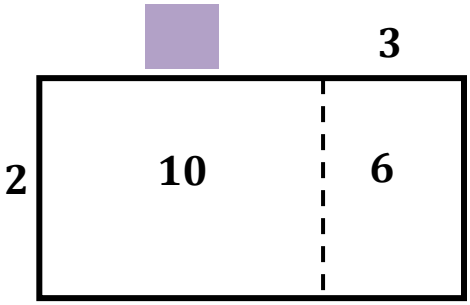
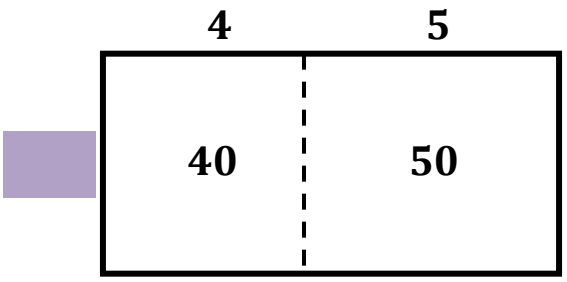


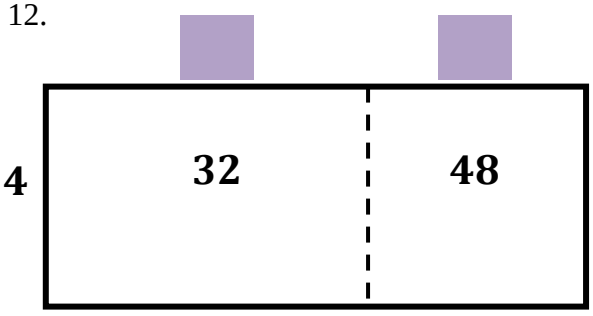
10.



11.



12.



13. Show how the Distributive Property works using the expressions given below.

a. $4(5+7) = 4(5) + 4(7) = 20 + 28 = 48$

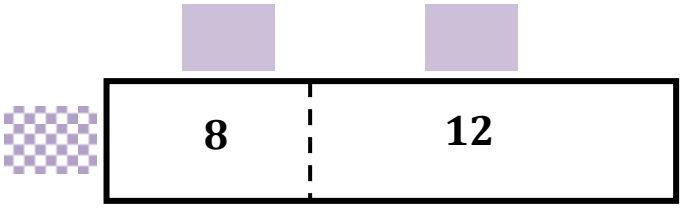
b. $9(7-2) = 9(7) + 9(-2) = 63 + (-18) = 45$

The Distributive Property
To multiply a number by a sum or difference, multiply each number in the sum or difference by the number outside the parentheses.

$$a(b+c) = ab + ac$$
$$a(b-c) = ab - ac$$

For the next few problems students must focus on finding common factors of the two numbers in the given sum. It is okay if students do not immediately identify the greatest common factors at this point. You will notice that there are no problems with subtraction. In 6th grade students are only required to factor a sum of two whole numbers.

14. Lou states that for the area model below the number behind the checkered box is 2.

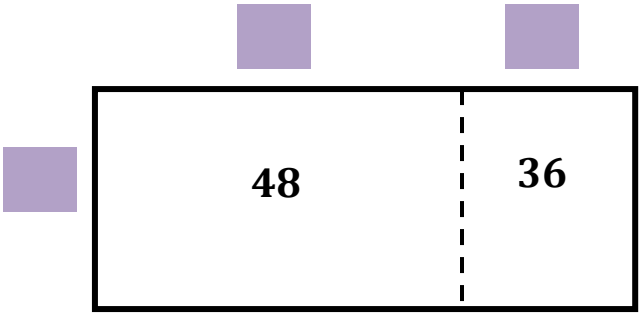


a. Is Lou correct? If so, what must the other missing numbers be? Write a mathematical sentence that describes this area model.

b. Are there any other numbers that could be behind the checkered box? If so, what would the other missing numbers be? Write mathematical sentences to describe the area model with these other dimensions as well.

c. How do these other numbers affect the length and width of the rectangle? Would the area change? Why or why not?

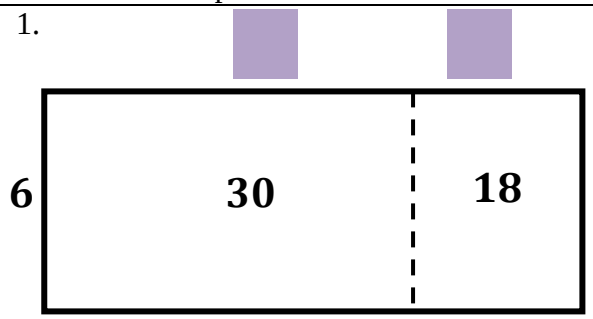
13. Find the missing numbers for the area problem below. List all possible combinations and write a mathematical sentence for each combination.



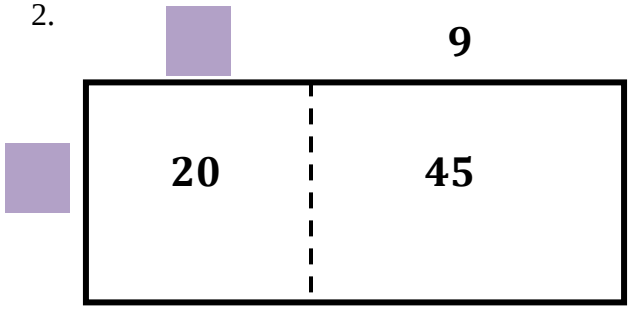
0.2d Homework: The Distributive Property

Name the factor, product, or addend that is missing from the area model. Then write a mathematical equation that shows the multiplication that the area model represents. Models are not drawn to scale.

1.



2.



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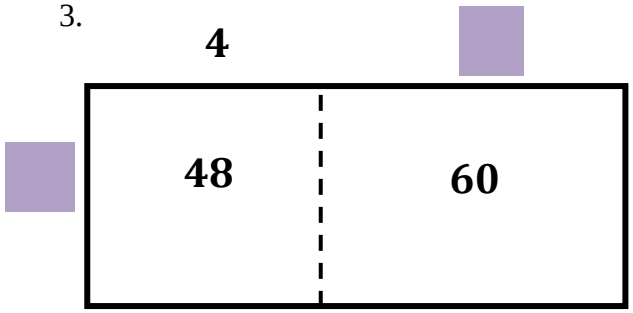

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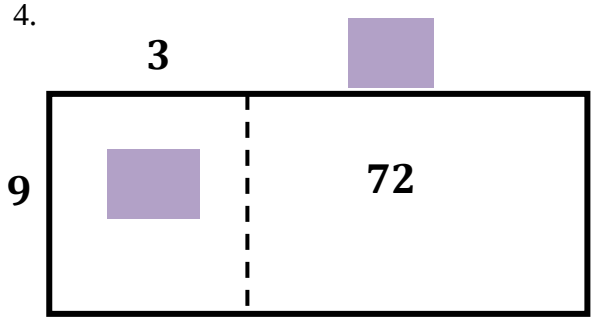
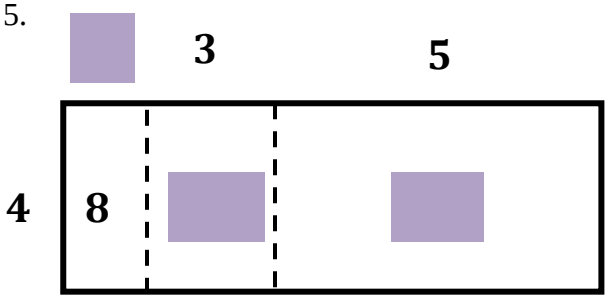


5.



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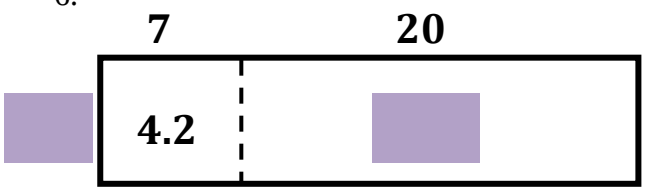
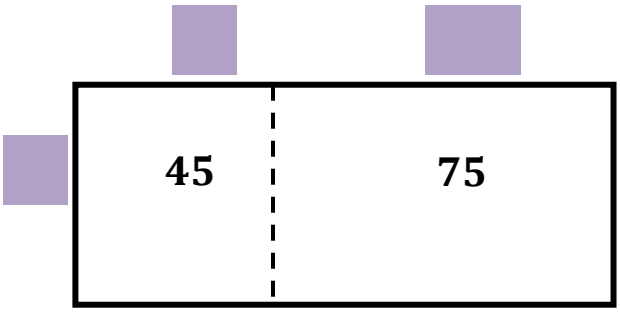


7. Circle all the expression that are equivalent to $12 + 30$

$5(2 + 6)$	$2(6 + 15)$	$1(12 + 30)$	$10(2 + 3)$
$6(2 + 5)$	$10(2 + 3)$	$4(3 + 8)$	$3(4 + 10)$

Directions: Find the missing numbers for the area problem below. List all possible combinations and write a mathematical sentence for each combination.

8.



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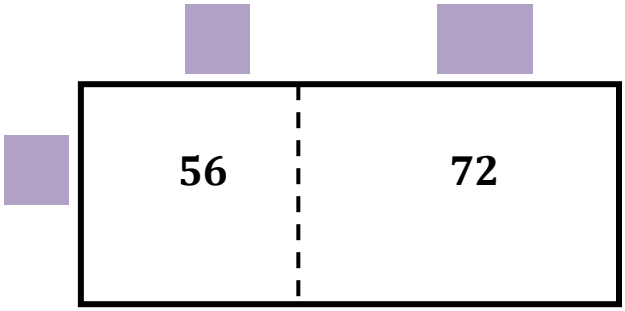

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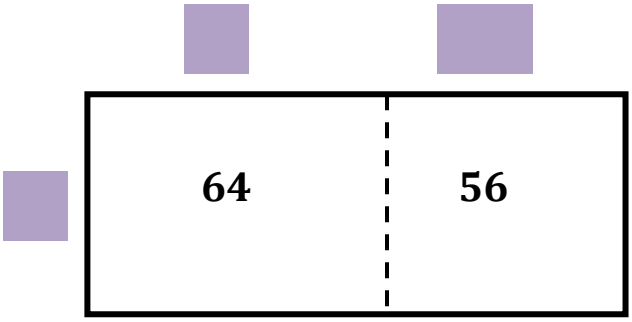

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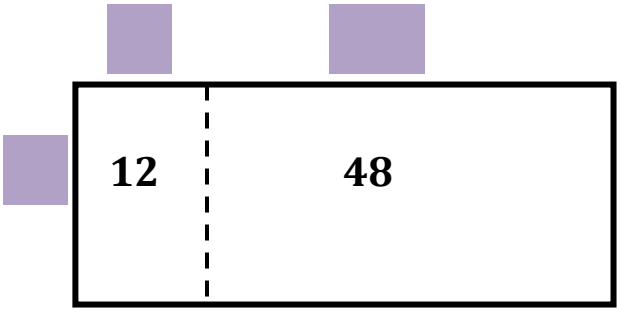

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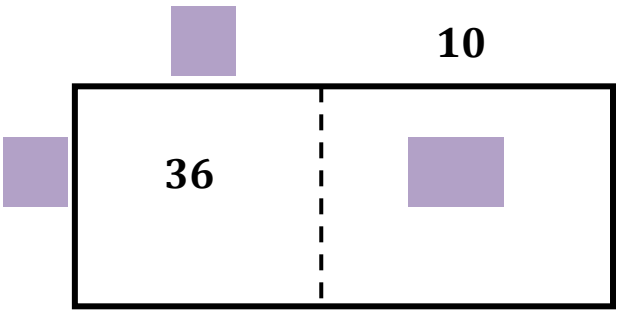


0.2e Class Activity: Using the Distributive Property To Find Equivalent Expressions

1. Use the distributive property to write all the equivalent expressions for the sum of $(36 + 12)$. If needed draw a model to reference.

2. Use the distributive property to find all the equivalent expressions for $24 + 32$

3. Examine the equivalent expressions for the sum in number 2 above. Circle the expression that contains a factor that is the GCF of 24 and 32? What is the other factor in this product? How does this factor partner differ from the other factor partners in the other equivalent expressions?

4. Examine the equivalent expressions for the sum in number 1 as well. Which expression contains a factor that is the GCF of 36 and 12? How does its factor partner differ from the other factor partners in the other equivalent expressions?

5. Use the distributive property to find all the equivalent expressions for each sum given. Circle the expression that contains a factor that is the GCF of the two addends in the original sum. Check and see if this expression follows the same principle as the expressions with the GCF from numbers 1 and 2 above.

a. $45 + 60$	b. $42 + 70$	c. $20 + 60$

6. Find the GCF of the two numbers in each given sum. Use the distributive property to write an equivalent expression to the sum that contains the GCF as one of its factors. How do you know that you found the correct equivalent expression?

a. $42 + 14$	b. $36 + 27$
c. $55 + 44$	d. $16 + 72$

7. Nina was finding multiples of 6. She states,

"18 and 42 are both multiples of 6, and when I add them, I also get a multiple of 6."

$$18 + 42 = 60$$

Explain to Nina why adding two multiples of 6 will always result in another multiple of 6.

**This is an Illustrative Mathematics Task*

0.2e Homework: Using the Distributive Property To Find Equivalent Expressions

Directions: Use the distributive property and the GCF to write an equivalent expression for each given sum.

1. List the factors of 24:

   List the factors of 60:

   What is the GCF of 24 and 60:

   Use the GCF to write an equivalent expression for $24 + 60$

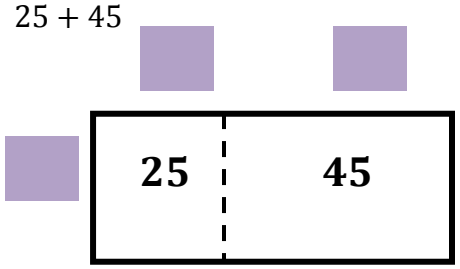
2. List the factors of 42:

   List the factors of 49:

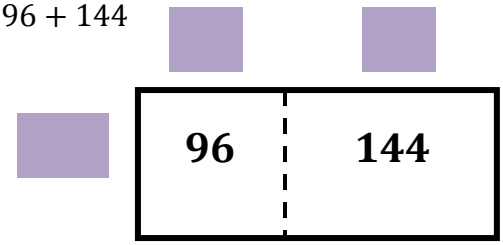
   What is the GCF of 42 and 49:

   Use the GCF to write an equivalent expression for $42 + 49$

3. $25 + 45$



4. $96 + 144$



5. $16 + 36$

6. $54 + 81$

7. $72 + 32$

8. $34 + 17$

9. $35 + 75$

10. $13 + 15$

11. Create your own example that uses the distributive property to rewrite a sum as an equivalent expression using the GCF. Choose numbers for a, b, and n, where n is the GCF of a and b.

$$a + b = n(a) + n(b) = n(a + b).$$

Section 0.3: Arithmetic Operations with Decimals

Section Overview:
The last section of this appendix returns to work that students have done in previous grades with arithmetic operations of decimals. In this section students build upon their knowledge of operations with multi-digit whole numbers and extend similar reasoning to multi-digit decimals. They connect the modeling done in previous grades with decimals addition and subtraction and extend this to algorithms for adding and subtracting decimals. Next they do the same thing with multiplying multi-digit decimals. They draw upon the modeling and work done in previous grades and connect them to an algorithm for decimal multiplication. Finally they deal with multi-digit decimal division, similarly connecting the work done in previous grades with modeling to an algorithm. Throughout this section students also work on achieving fluency with these arithmetic operations by estimating, using mental math, converting between fractions and decimals, etc.

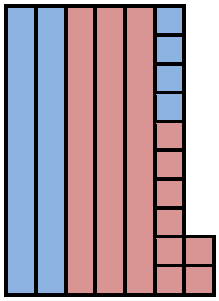
Concepts and Skills to Master in this Section:

By the end of this section, students should be able to:

1. Fluently add multi-digit decimals using the standard algorithm.
2. Fluently subtract multi-digit decimals using the standard algorithm.
3. Fluently multiply multi-digit decimals using the standard algorithm.
4. Fluently divide multi-digit decimals using the standard algorithm.

0.3a Class Activity: Adding and Subtracting Multi-Digit Decimals

Marta has created the model below. She claims that this model can be used to represent the sum of 24 and 38.



4. If Marta's claim is true, what is the value of the small square?

5. What is the value of a rod (long rectangle)?

6. Find the sum of 24 and 38 using the addition algorithm and discuss how this relates to the model above.

Using the same model now suppose that the small square represents **0**.**1**.

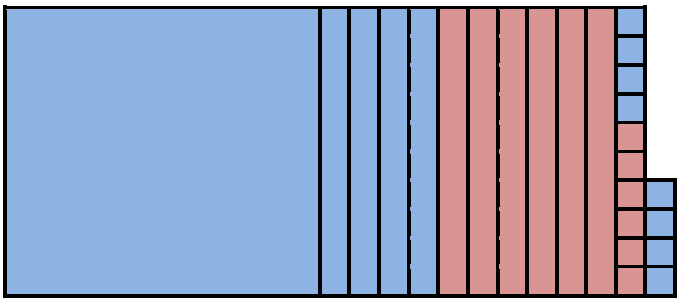
7. What would the value of the rod be?

8. What would the sum be equal to?

9. Find the sum supposing that the small square represents 0.1 using the addition algorithm and discuss how this relates to the model.

10. What other sums might be represented with this model? Find at least two and for each sum identify what a square represents and what a rod represents.

Study the new model below.



11. Irina claims that the model represents the sum of $\mathbf{1480}$ and $\mathbf{660}$. For this to be true what is the value of a small square, a rod, and large square?

12. What does the sum equal altogether? Use the addition algorithm to find the sum as well.

13. Carly states that when she looks at the model she sees the sum of $0.\mathbf{148} + \mathbf{0.066}$. For Carly's statement to be true what is the value of a small square, a rod, and a large square?

14. What does Carly's sum equal altogether? Use the addition algorithm to find the sum as well. Discuss how the algorithm relates to the model.

15. If needed draw a model to find the following sums. Name what the small squares represent and then find each sum using the addition algorithm.

a. $\mathbf{0.015 + 0.083}$	b. $\mathbf{0.029 + 0.045 =}$
c. $\mathbf{0.37 + 0.048}$	d. $\mathbf{0.091 + 0.037}$
e. $\mathbf{1.37 + 2.05}$	f. $\mathbf{0.103 + 0.0091}$

13. Draw models to find the following differences. Then find each difference using the subtraction algorithm.

a. $\mathbf{0.358 - 0.125}$

b. $\mathbf{0.243 - 0.15}$

c. $\mathbf{0.34 - 0.054}$

14. Bev has $35.65. She buys a candy bar for $0.89 and package of pens for $3.56.

    a. How much money did Bev spend?

    b. How much money does she have leftover?

15. Peyton is driving to college, her college is $345\frac{11}{50}$ miles away from her parent's home. She has already driven $24\frac{9}{10}$ miles. How much further does she need to drive? Estimate your answer before calculating.

0.3a Homework: Adding and Subtracting Multi-Digit Decimals

Directions: Find each sum or difference.

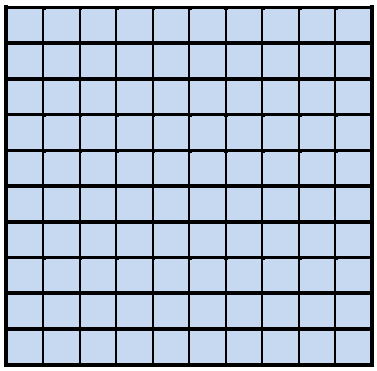
1. $4.398 + 70.04$	2. The three sides of a triangle have the measurements of 2.32 cm, 15.4 cm and 112.09 cm. What is the perimeter of the triangle?	3. $\frac{677}{1000} + \frac{3}{10} + 10\frac{6}{10}$
4. Portia is painting a room. She needs $4\frac{4}{5}$ of a gallon of white paint, $2\frac{1}{10}$ of a gallon of light blue paint, and $1\frac{9}{25}$ of a gallon of grey paint. How many gallons of paint does she need altogether?	5. $13\frac{21}{50} + 14.0389 + 13.08$	6. $54.07 - 8.3955$
7. $66.7 - 0.392$	8. Carlotta has a piece of wood that measures 0.8392 meters; she cuts off a piece that is 0.05 meters. How much wood does she have left?	9. $42\frac{3}{4} - 11\frac{1}{2}$
10. $1.7 + 4\frac{3}{100} - 2.303$	11. Malone got 8 out of 10 on his last spelling test. On the next test he got 76%. What is the sum of the two test percentages?	12. Write three decimals that have a sum of 114.056.

0.3b Class Activity: Multiplying Muli-Digit Decimals

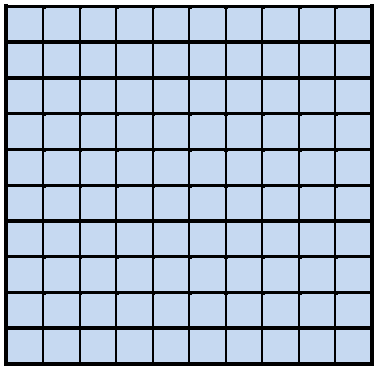
Part 1

Use the model given to discuss the following questions.

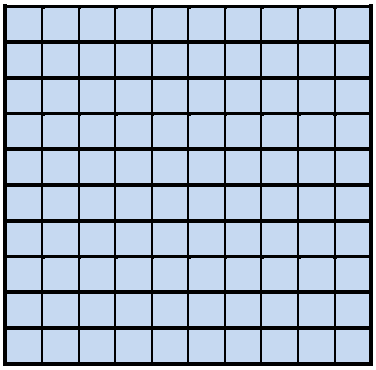
1. Assume the side length of the large square is 10.
   What is the area of the large square? What is the side length of a small square? What is the area of the small square?



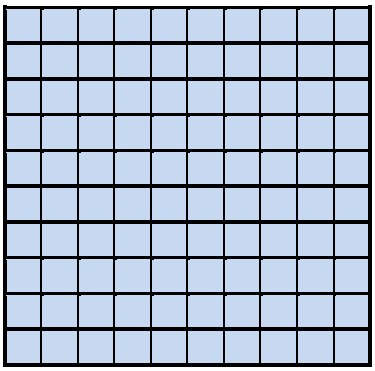
2. Now assume the side length of the large square is 100.
   What is the area of the large square? What is the side length of a small square? What is the area the small square?



3. Now assume the side length of the large square is 1.
   What is the area of the large square? What is the side length of a small square? What is the area the small square?



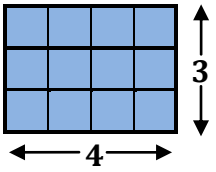
4. Assume the side length of the large square is 0.1.
   What is the area of the large square? What is the side length of a small square? What is the area the small square?



5. Summarize your thinking by stating the following products
   a. $10 \times 10 =$
   b. $1 \times 1 =$
   c. $0.1 \times 0.1 =$
   d. $0.01 \times 0.01 =$

Part 2

1. Use the model below to answer the questions that follow.



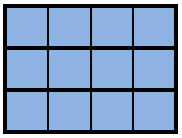
a. What is the length of each unit?

b. What is the area of each small square?

c. What is the area of the rectangle?

d. Write a multiplication equation that represents the dimensions and area of this rectangle.

2. Now suppose the length of each unit is 0.01.



a. Label the length of each unit (small square) on the rectangle and label the side lengths of the rectangle.

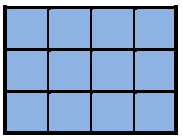
b. What is the area of each small square?

c. What is the area of the rectangle?

d. Write a multiplication equation that represents the area of the rectangle above.

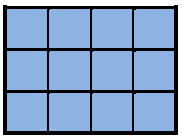
For problems 3 through 8 label each rectangle with the given dimensions so that it represents the multiplication equation. Label the dimensions of each unit (small square). Find the area of each small square and the area of each rectangle that represents the solution to each equation. Then write the solution to the equation.

3. $40 \times 30 =$



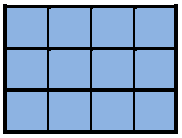
Area of the small square:
Area of the rectangle:

4. $0.04 \times 0.03 =$



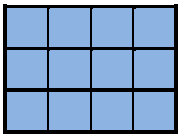
Area of the small square:
Area of the rectangle:

5. $0.003 \times 0.004 =$

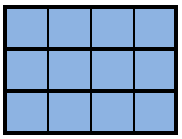
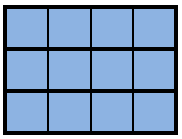


Area of the small square:
Area of the rectangle:

6. $0.4 \times 3 =$



Area of the small square:
Area of the rectangle:

7. $4 \times 30 =$  Area of the small square: Area of the rectangle:	8. $0.04 \times 0.3 =$  Area of the small square: Area of the rectangle:

Part 3

1. Use the fact that $16 \times 12 = 192$ to find each product. Justify your answer using an estimation argument and by discussing the placement of the decimal point or the expected number of zeros in the product.

   a. $16 \times 1.2 =$

   b. $160 \times 12 =$

c. $160 \times 120 =$

d. $1600 \times 12 =$

e. $1.6 \times 1.2 =$

f. $0.16 \times 1.2 =$

g. $0.16 \times 0.12 =$

2. Dallin has begun to do the following multiplication problem. His work is shown below; he does not know where to place the decimal point in the product. Correctly place the decimal point for him and justify your answer.

$$\begin{array}{r} {\scriptstyle 1} \\ 4.37 \\ \times\ 1.25 \\ \hline 2185 \\ +\ 8740 \\ \hline 10925 \\ +43700 \\ \hline 54625 \end{array}$$

Directions: For each problem estimate the product. Then find the product by changing the decimals to fractions. Check your answer by using the multiplication algorithm.

3. 25.62×11.7

   Estimation:

   Convert to Fractions:

   Standard Algorithm:

4. You work part time at a book store and get paid $12.05 per hour. In the entire month of March you worked 78.25 hours. How much money did you make in March?

   Estimation:

   Convert to Fractions:

   Standard Algorithm:

0.3b Homework: Multiplying Multi-Digit Decimals

Directions: Solve each problem below; be sure to estimate your answer first. (Hint: If desired and appropriate change your decimals to fractions in order to evaluate.)

1. 423.56×63.72	2. Sienna spends \$27.50 on coffee and a Danish for breakfast each week for an entire semester. How much money does she spend on breakfast for the semester if there are 16.25 weeks in a semester?
3. Flora is designing a triangular structural beam. The base of the triangular beam measures 14.002 meters and the height is 3.85 meters. Find the area of the triangular beam?	4. 0.000125×0.005
5. $1.037 \times 5 - 0.68$	6. 0.0021×14.2
7. A person's weight on the moon is about 0.167 of their weight on Earth. How much does a 168 pound astronaut weigh on the moon?	8. $5.32(4.2 + 1.85)$

9. Describe each pattern given below, then find the next two terms.
   a. $1, 0.3, 0.09, 0.027$ ...

   b. $17, 0.17, 0.0017$...

   c. $10, 15, 22.5, 33.75$ ...

10. Andrei has enough ceramic tiles to cover a rectangular patio area of 60.75 ft^2. He has made a list of possible dimensions he could use for the rectangular patio. Some of these dimensions are wrong. Circle the dimensions that will **not** work for an area of 60.75 ft^2. Explain why these dimensions will not work.
    - 27 ft × 2.25 ft
    - 2.7 ft × 22.5 ft
    - 0.27 ft × 22.5 ft
    - 27 ft × 22.5 ft
    - 27 ft × 22.50 ft
    - 0.27 ft × 225 ft
    - 270 ft × 0.225 ft

11. You and two friends are going out for lunch at a restaurant. The menu for the restaurant is shown. Use the menu to choose lunch items for you and your friends then complete the following.
    a. Write the item and its price on the check provided.
    b. Find the subtotal for your total bill.
    c. Multiply the subtotal by 0.07 to find the sales tax and then find the total bill with tax.
    d. Find 20% of the total bill to determine how much money you should leave as a tip.

GUEST CHECK		
Date	Invoice # 568345	
	Subtotal:	
	Tax:	
Tip:	Total:	

Lunch Menu

Sandwiches

Turkey or Ham.....$5.40
Tuna.....$4.75
Chicken.....$6.20

Pizza by the slice

Pepperoni.....$3.75
Hawaiian.....$4.30
Cheese.....$ 3.50

Salads

Caesar.....$8.30
BBQ Chicken.....$9.45
Spinach Strawberry...$7.60

Drinks

Soda.....$1.75
Lemonade.....$2.05
Bottled Water.....$1.60

0.3c Class Activity: Dividing Muli-Digit Decimals

Roxy has bins of loose candy at her shop. She sells Creamy Dreamies for $0.75 each, Sour Powers for $0.25 each and Gummy Yummies for $0.05 each. She has also decided to sell bags of each different kind of candy for $3.00 a bag. How many of each candy will be in a $3.00 bag? Draw a model to find your answers.

Creamy Dreamies

Sour Pours

Is there a way that you can find the number of Gummy Yummies in a bag without drawing model?

Try your method with Creamie Dreamies and the Sour Powers to see if you get the same answer.

Directions: For each problem determine what number you can multiply the dividend and divisor by so that you get a whole number divisor. If needed re-write each division problem as a fraction. Then re-write each quotient with a whole number divisor.

1. $63 \div 3.5 =$	2. $603 \div 50.25 =$	3. $18.2 \div 1.4 =$
4. $0.75 \div 0.15 =$	5. $1{,}488 \div 0.024 =$	6. $36.47 \div 0.7 =$
7. $0.52 \div 0.001 =$	8. $0.987 \div 12.3 =$	9. $4.23 \div 0.012 =$

Now re-write each problem as a quotient with a whole number divisor by moving the decimal points. Check to see if it matches the quotient you wrote above. Then calculate each quotient.

10. $63 \div 3.5$	11. $603 \div 50.25$	12. $18.2 \div 1.4$

13. $0.75 \div 0.15$	14. $1{,}488 \div 0.024$	15. $36.47 \div 0.7$
16. $0.52 \div 0.001$	17. $0.987 \div 10.5$	18. $4.23 \div 0.012$

Explain in your own words how to divide decimals by decimals

To divide a decimal by a decimal

0.3c Homework: Dividing Multi-Digit Decimals

Directions: Solve each problem below; estimate your answer first. Round your answer to the nearest thousandth unless otherwise specified.

1. $2143 \div 2.3$	2. $0.408 \div 0.51$
3. A car travels 284.49 miles in 4.35 hours. What is its unit rate?	4. $2.3835 \div 0.0007$
5. Sunny Skies Sunscreen comes in a 4 oz tube and costs \$8.49. Beach Balance Sunscreen comes in 5.5 oz tubes and costs \$10.29. Which sunscreen is the better deal? Justify your answer.	6. $0.18 \div 0.0027$
7. Place the decimal in the correct location for each quotient. a. $14.6 \div 4 = 365$ b. $6.38 \div 11 = 58$ c. $88.27 \div 7 = 1261$ d. $15.38 \div 0.05 = 3076$	8. The thickness in centimeters of four different coins are given below. Find the average mean thickness of all four coins. Penny- 0.152 cm Nickel- 0.195 cm Dime- 0.135 cm Quarter- 0.175 cm
9. The area of a rectangular painting is 720.5 inches. The length is 36.0625 in. Find the width of the painting. Round your answer to the nearest hundredth.	10. Without calculating fill in the blank with $<, >,$ or $=$. a. $33.6 \div 0.7$___$3.36 \div 7$ b. $152.52 \div 16.4$___$152.52 \div 1.64$ c. $100.8 \div 1.6$____$10.08 \div 0.0016$ d. $5.92 \div 0.74$____$59.2 \div 7.4$

0.3d Class Activity: Solving Problems with Multi-Digit Decimals

Directions: Perform each indicated operation.

1. $0.5 + 1.674$	2. $4.192 - 1.255$	3. $14.9(0.56)$	4. $2.92 \div 0.002$
5. Add 26.59, 1.80, and 13.	6. Find the difference of 42.05 and 11.621	7. Find the product of 13.6 and 901.15.	8. What is the quotient of 72.05 and 0.11?

Use mental math to perform each indicated operation. Be ready to discuss your mental math strategies.

9. $99 + 36$

10. $42 - 29$

11. 50×8

12. $120 \div 5$

Perform each indicated operation using two different methods. Be ready to discuss your prefered method. Round each answer to the nearest thousandth.

13. $0.5 \div 0.1$

Method 1:	Method 2:

14. 7.05×24.25

Method 1:	Method 2:

Solve each problem

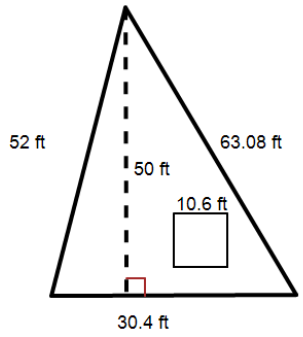
**The following three probems are Illustrative Mathematics Tasks.*

15. A group of 10 scientists won a $1,000,000 prize for a discovery they made. They will share the prize equally. How much money will each person get?

16. Two cousins shared 0.006 kilograms of gold equally. How many kilograms of gold did each cousin get?

17. A barrel contained 160 liters of oil that costs $51.20. What is the cost for one liter? How many liters can you buy for $1.00?

18. A preschool is putting new fence up in their triangular play yard and they are planting grass. Use the picture below to answer the questions that follow.



a. If the fence is to go around the perimeter of the triangular yard how much fencing will they need?

b. The grass will be planted everywhere in the yard except in the square sandbox. How many square feet of grass will they need to plant.

c. Grass costs $0.35 per square foot. How much money will they spend on the grass?

d. The fencing comes in panels of 9.25 ft. How many panels of fencing do they need to order?

19. Hallie is in 6th grade and she can buy movie tickets for $8.25. Hallie's father was in 6th grade in 1987 when movie tickets cost $3.75.
This is an Illustrative Mathematics Task

a. When he turned 12, Hallie's father was given $20.00 so he could take some friends to the movies. How many movie tickets could he buy with this money? How much money would he have leftover?

b. How many movie tickets can Hallie buy for $20.00? How much money will she have leftover.

c. On Hallie's 12th birthday, her father said,

When I turned 12, my dad gave me $20 so I could go with three of my friends to the movies and buy a large popcorn. I'm going to give you some money so you can take three of your friends to the movies and buy a large popcorn.

How much money do you think her father should give her?

0.3d Homework: Solving Problems Multi-Digit Decimals

Directions: Perform each indicated operation.

1. $0.6 + 2.633$	2. $5.13 - 1.356$	3. $17.4(0.23)$	4. $4.45 \div 0.005$
5. Add 26.53, 1.6, and 340	6. Find the difference of 324.05 and 9.623	7. Find the product of 1.2 and 822.15	8. What is the quotient of 42.05 and 0.022?
9. $9.43 - 0.18$	10. $1.01(6.2)$	11. 0.47×3.01	12. $4.192 + 1.255$
13. $9.2 \div 0.375$	14. $500 \div 3.2$	15. $41.3 + 0.28 - 14.005$	16. $2500 - 2350.006$

Solve each problem

Problems 19 and 20 are Illustrative Mathematics Tasks

19. Jayden has $20.56. He buys an apple for 79 cents and a granola bar for $1.76.

    a. How much money did Jayden spend?

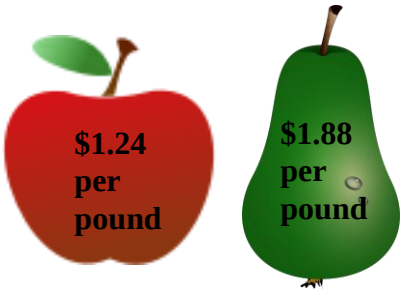
    b. How much money does Jayden have now?

20. Seth wants to buy a new skateboard that costs $167. He has $88 in the bank.
    a. If he earns $7.25 an hour pulling weeds, how many hours will Seth have to work to earn the rest of the money needed to buy the skateboard?

    b. Seth wants to buy a helmet as well. A new helmet costs $46.50. Seth thinks he can work 6 hours on Saturday to earn enough money to buy the helmet. Is he correct?

    c. Seth's third goal is to join some friends on a trip to see a skateboarding show. The cost of the trip is about $350. How many hours will Seth need to work to afford the trip?

21. You buy 2.8 pounds of apples and 1.375 pounds of pears. You hand the cashier a $20 bill. How much change will you receive?



22. A box company makes a certain box in two sizes. The material used to make both boxes costs $1.50 per square foot. Use the information below to answer each question

	Length	Width	Height
Box 1	15.5 cm	4.06 cm	3 cm
Box 2	10.85 cm	5 cm	3.48 cm

a. What is the volume of each box?

b. How much does a person save by choosing to make Box 2 instead of Box 1.

23. A car can travel 50.7 miles on 2 gallons of gasoline.

a. How far can the car travel on 9.5 gallons of gasoline?

b. A hybrid car can travel 68.4 miles on 2 gallons of gasoline. How much farther can the hybrid car travel on 9.5 gallons of gasoline?

24. Tickets to the school play cost $5.25. The amount received from tickets sales is $640.50. How many tickets were sold?